

## The Chemical Nature of Matter

**7-5 The student will demonstrate an understanding of the classifications and properties of matter and the changes that matter undergoes. (Physical Science)**

**7-5.10 Compare physical changes (including changes in size, shape, and state) to chemical changes that are the result of chemical reactions (including changes in color or temperature and formation of a precipitate or gas).**

**Taxonomy level:** 2.6-B Understand Conceptual Knowledge

**Previous/Future knowledge:** Students have not been introduced to the concepts of physical or chemical changes before this grade level. They will further develop the concept of physical and chemical changes in high school Physical Science (PS-4.6).

**It is essential for students to know** that physical and chemical changes affect substances in different ways.

*Physical changes* do not change the composition of a substance, only the physical properties. Evidences of a physical change include:

### *Change in state of matter*

- When a substance changes from one state of matter to another (for example, changing from solid to liquid, from liquid to solid, or from liquid to gas), the composition of the substance remains the same.
- Examples of change in state might include: melting of ice cream, hardening of melted wax, or evaporating of water from wet clothes.
- When a substance changes directly from a gas to a solid (the forming of frost from water vapor) or from a solid to a gas (dry ice, solid air fresheners) that change of state is called *sublimation*. This is still a physical change because the composition of the substance remains the same.

### *Change in size or shape*

- When a substance changes in size or shape (for example, cutting, tearing, dissolving, stretching, or wrinkling), its composition remains the same.
- Examples of change in size or shape might include: shredding paper, dissolving sugar in water, stretching a rubber band, wadding up a piece of paper, or denting a piece of metal.

*Chemical changes* result in the formation of one or more new substances with new chemical and physical properties. Evidences that a chemical change may have occurred include:

### *Color change*

- When a substance changes color, the chemical composition of the substance may have changed (for example, iron turns to a reddish-brown when it rusts, clothes change color when bleach is added, apples turn brown when they react with oxygen in the air, or marshmallows turn black when burned).
- It is possible to have a color change without a chemical change (for example, adding food coloring to water).

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#### *Temperature change*

- When a substance is combined with another substance, there may be an increase or decrease in temperature (for example, when wood burns to ash and gases, the temperature increases).
- It is possible to have a temperature change without a chemical change (for example, warming of the water in a pond).

#### *Formation of a precipitate*

- When two solutions are combined, they may form a solid substance. This solid substance is called a *precipitate* and indicates that a chemical change has occurred.
- For example when carbon dioxide is combined with aqueous calcium hydroxide (limewater), solid calcium carbonate (chalk) is formed as the precipitate.
- The precipitate may be in the form of very small particles, appearing as cloudiness in the solution or as a solid which settles to the bottom of the container.

#### *Formation of a gas*

- When solid or liquid substances are combined, they may form gas bubbles.
- The formation of the gas may indicate that a chemical reaction has taken place. For example when vinegar is added to baking soda, it forms carbon dioxide bubbles.
- It is possible to form gas without a chemical change (for example, when water is heated to boiling).

**It is not essential for students to** identify a reaction as exothermic or endothermic.

#### **Assessment Guidelines:**

The objective of this indicator is to *compare* physical changes to chemical changes; therefore, the primary focus of assessment should be to determine how physical and chemical changes are alike and different. However, appropriate assessments should also require students to *identify* a given change as physical or chemical; *exemplify* physical and chemical changes; *infer* whether a physical or chemical change has occurred based on the conditions given; *classify* changes as chemical or physical based on descriptions given; or *summarize* the evidences for a chemical change.